Abstract Submitted
for the DFD20 Meeting of
The American Physical Society

A Bayesian approach for predicting and filtering linear and nonlinear thermoacoustic oscillations[1] ANDREA NOVOA MARTINEZ, LUCA MAGRI, University of Cambridge — The modelling of thermoacoustic oscillations is typically based on qualitative models. We propose a Bayesian approach to make a prototypical thermoacoustic model quantitatively accurate by combining model predictions with data. We investigate both linear (around a fixed point) and nonlinear (limit cycle, frequency locked, quasiperiodic, chaotic) regimes. We design a square-root filter by reformulating the time-delayed problem into a Markov chain. The filter updates the ensemble mean without artificially sampling the measurement error, which overcomes the limitation of standard ensemble Kalman filters. We simulate a multi-microphone experiment where measurements are taken from multiple pressure sensors. Numerical experiments are performed to analyse the filter's performance in linear and nonlinear regimes. We propose sampling strategies based on the NyquistShannon criterion and positive Lyapunov exponent. The filter is robust and capable of predicting the reference state even in the presence of large measurement errors. This work opens up new possibilities for the quantitative prediction of self-excited thermoacoustic oscillations by on-the-fly assimilation of experimental data into reduced-order models.

[1]Royal Academy of Engineering Research Fellowships

Luca Magri
University of Cambridge

Date submitted: 03 Aug 2020 Electronic form version 1.4